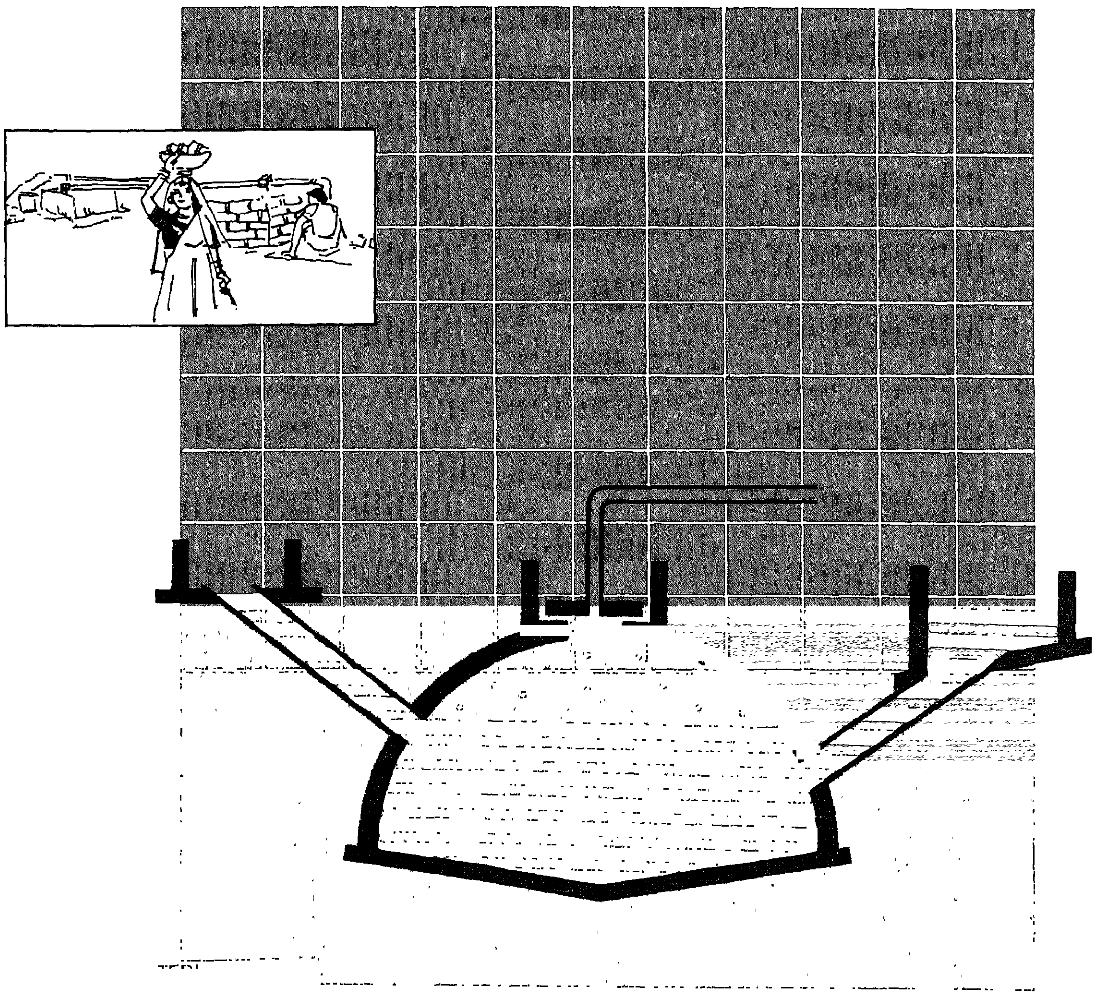
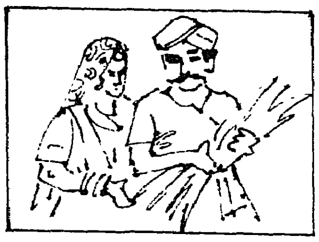
MANAGING THE BIOGAS PROGRAMME





Tata Energy Research Institute

Managing the BIOGAS PROGRAMME

TATA ENERGY RESEARCH INSTITUTE

Sponsored by Ministry of Non-conventional Energy Sources

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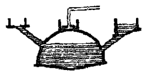

The National Project on Biogas Development (NPBD), has, over the last decade, established itself as one of India's largest and most important renewable energy programmes to meet the rural energy requirements. The 1.76 million biogas plants installed during this period have reached practically every corner of the country, making a discernible impact in improving the quality of life of the rural populace. However, given the vast and the ever-growing energy demand in the rural areas, biogas clearly has, with its immense potential, a greater role to play in the future. Thus, it is important at this stage to take a fresh look at various aspects of NPBD so as to gear the programme to meet the future challenges. Implementation process is one such aspect that needs close examination as it has been the experience of NPBD that, other things being equal, it is the implementation process that determines the success or failure of the programme in specific regions. Given the fact that different implementation strategies have been adopted by different agencies under the broad framework of NPBD, a review of these strategies would have significant policy implications for the future of the biogas programme. This document is an attempt to discuss and review the implementation strategy of the NPBD.

Biogas—a versatile fuel

India with its huge bovine population has an abundant supply of animal dung (an estimated 245 million tonnes per annum). Its value as manure and as a source of fuel has been known to the farmers for centuries. However, a given quantity of dung could be put only to one use, that is, as manure in agricultural fields or as cooking fuel in the form of dung-cakes. It was only in the last fifty years or so that the biogas technology has enabled a dual use of this resource, as a source of fuel and as a rich organic manure. Thus, biogas can be called the archetypal appropriate technology, for, it makes optimal use of a valuable natural resource like animal dung, to provide a nutrient rich manure as well as a clean, efficient fuel.

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Biogas can be called the archetypal appropriate technology.

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Biogas is generated through a microbial process leading to fermentation of organic matter in absence of oxygen (anaerobic condition), to produce a mixture of gases. This mixture, a combination of methane and carbon dioxide with traces of sulphur dioxide and hydrogen, is highly combustible. As a source of fuel, biogas is extremely versatile and is used for a variety of applications such as cooking, lighting, running engines, and even generating electricity. As a cooking fuel, biogas serves as a convenient, smoke-and soot-free fuel. By providing a clean cooking atmosphere, biogas can help eliminate various eye, throat and lung diseases Indian housewives are otherwise susceptible to in their smoke-filled kitchens. Biogas is also used in combination with diesel in dual-fuel engines for mechanical power operations. The slurry that comes out of a biogas plant is rich in nutrients and can be used in agricultural fields as an organic manure. In some states like West Bengal, biogas slurry is also used as fish feed in pisciculture.

Biogas in India

Evolution of biogas technology

Biogas technology entered India nearly a century ago, when gas produced from sewage was utilized to light a sanatorium in Bombay in 1897. Research into cow-dung based plant designs was carried out by several institutions beginning from the forties—notable among the efforts were those of the Indian (then Imperial) Agricultural Research Institute, Delhi; Khadi Pratisthan, Calcutta; Swami Vishwakarmananda, Calcutta; etc. But these efforts remained isolated with little co-ordination among them. Nevertheless, they continued and the first working model of a biogas plant, *Gramalakshmi* was developed in 1952 by Jashbhai Patel, a Gandhian worker from Gujarat. After successive improvements, *Gramalakshmi III* was successfully tested which later became the prototype for the *KVIC* floating drum biogas plant.

In the early sixties, research on biogas plants was also begun by PRAD (Planning, Research and Action Division) of the Government of Uttar Pradesh leading to the development of *Janata* model in 1977. *Janata* model was based on the popular Chinese fixed masonry dome design. The major advantage of *Janata* compared to *KVIC* model has been its low cost, only two-thirds that of the latter.

However, perhaps the most important technological breakthrough, as far as biogas is concerned, took place in 1984 with the development of *Deenbandhu* fixed dome model by the scientists of AFPRO (Action for Food Production), a voluntary organisation. This model, with reduced material requirements due to design optimisation, has proved to be even cheaper than *Janata*. Since then, *Deenbandhu* has become the most popular biogas plant model whose pre-eminent position is still intact.

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As a source of fuel, biogas is extremely versatile.

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During the eighties, there have been a few other models developed, such as *Pragati*, Ferro-cement Digester, FRP Gasholder, etc., but these are mere variations of the basic *KVIC* or *Janata* design, different only in the material or in plant dimensions. A recent occurrence is the development of the portable *FLXI* model, made of rubberised nylon fabric.

Implementation efforts

In terms of actual field dissemination of biogas plants, no evidence is available on any systematic efforts on a large-scale before the sixties. The few attempts that were made in Uttar Pradesh, Gujarat, Orissa, etc., were too miniscule. Implementation in a planned manner was taken up for the first time by KVIC (Khadi and Village Industries Commission) in

1962. KVIC developed standard designs for plants of various capacities (3 to 140 cu.m) and installed them in different states. As the plant cost was high, KVIC arranged for subsidies and interest-free loans for its beneficiaries. These facilities were given to both individuals and institutions. It also trained rural youth in plant construction. In this way, by the early seventies, KVIC had not only installed a large number of successfully running plants but also created considerable expertise on various aspects of biogas technology.

It was this pool of expertise of KVIC that was able to reinforce the efforts of the central government when the latter started promoting biogas plants in the late seventies through the Ministry of Agriculture. The growing concern regarding the fuelwood crisis in the rural areas forced the policy makers to look for viable alternatives, and biogas was identified as one such option. In fact, the Fuel Policy Committee in 1974 and the Working Group on Energy Policy in 1979, both set up by the Planning Commission to look into the country's energy policy, considered biogas to be the most promising alternative energy source for the rural household sector.

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Biogas makes optimal use of a valuable resource like animal dung, to provide nutrient rich manure as well as clean, efficient fuel.

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National Project on Biogas Development (NPBD)

Through the pilot-scale efforts of a few organizations such as KVIC and PRAD, and the Ministry of Agriculture, biogas technology by the early eighties was reckoned to be mature enough to be disseminated on a large scale. Thus, the government of India launched NPBD (National Project on Biogas Development) in 1981, to be implemented by the Ministry of Agriculture.

This, however, was transferred within a few months, to the newly-formed Department of Non-conventional Energy Sources [now MNES (Ministry of Non-conventional Energy Sources)]. The programme was also included in 1982 in the Prime Minister's Twenty Point Programme to underscore its importance to the rural areas.

NPBD began with fairly conservative targets so far as dissemination was concerned. To ensure meaningful results, the initial activity was focussed in a hundred selected districts. For the entire Sixth Plan period (1980–85), a target of 335 000 plants was

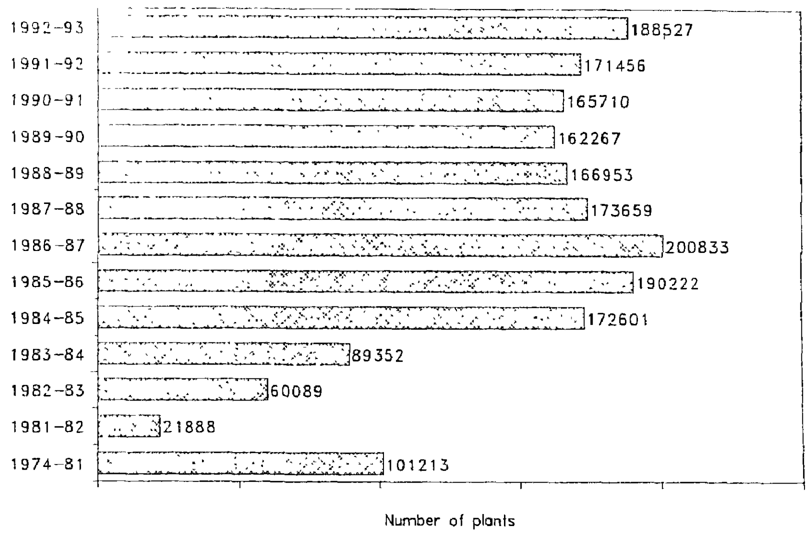
Objectives of National Project on Biogas Development

- To provide energy in a clean, unpolluting form
- To make available enriched fertilizer as a by-product for supplementing and optimizing the use of chemical fertilizers
- To reduce pressure on dwindling fuelwood supplies and prevent indiscriminate deforestation
- To eliminate the smoke-filled cooking environment, reduce drudgery, and prevent eye diseases
- To bring about an improvement in rural sanitation

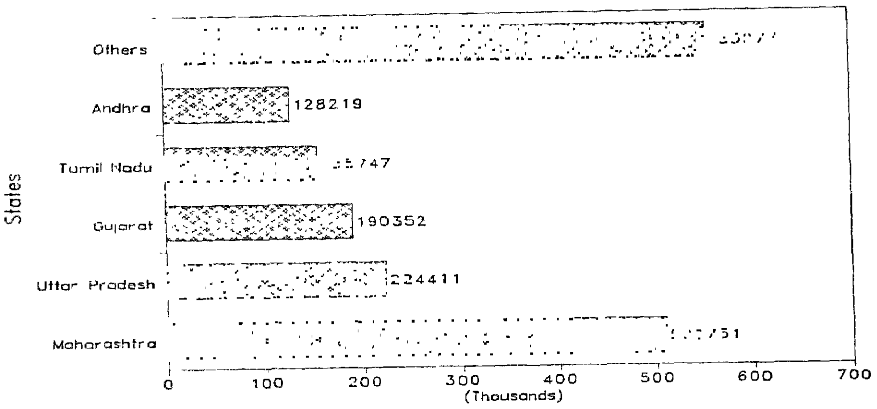
set, and by the end of it, the achievement was more than 100%. Including the 100 000-odd plants that were installed before NPBD, the total number of plants in the field by 1985 was well over 400 000. Ever since, the programme has made rapid strides, both in terms of numbers installed and the qualitative changes it has brought about in the lives of people.

The encouraging progress of NPBD during the Sixth Plan prompted enhanced targets for the Seventh Plan (1985–90). The programme that was restricted to specific districts was expanded to all the districts during 1985–86. By the end of Seventh Plan, approximately 1.33 million family size biogas plants were installed which went up to 1.76 million by March 1993.

Progress of NPBD



Achievements in NPBD
(cumulative upto 1992–93)



Performance

Though the programme has penetrated every nook and corner of the country, there are regional variations in performance, both in numbers and functionality rates. In terms of physical achievement, Maharashtra alone accounts for nearly one-third of the total plants installed. The other leading states are Gujarat, Tamil Nadu, Uttar Pradesh and Andhra Pradesh. As far as functionality rate is concerned, 85% of the plants were reported to be working well by the two rounds of evaluation surveys commissioned by MNES, and conducted in 1985–86 and 1987–88 by independent organizations such as Operations Research Group (ORG), National Council for Applied Economic Research (NCAER), and Indian Institute of Management (IIM). In a later survey conducted by NCAER in 1991–92, over 77% of the plants commissioned during the Seventh Plan were found to be functioning well. There is, however, significant variation across different states, which can to some extent, be attributed to regional factors such as climate, dung availability and physiography. Concurrently, social and cultural factors also play a critical role. For example, while Maharashtra and West Bengal are the leading states in toilet-linked biogas plants, people from other states are still largely inhibited in its use because of the social stigma attached to cooking on biogas generated from human waste. Certain other factors that have influenced the project performance are cattle ownership, availability of water, and ambient temperatures. In Gujarat, for instance, one of the major contributing factors to the success has been the good dung supply owing to a flourishing dairy industry. Some of these regional variations are reflected in predominance of different models in different areas. During the initial years, the KVIC

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Maharashtra accounts for nearly one-third of the total 1.76 million biogas plants installed.

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floating drum model and *Janata* fixed dome model were very popular. But because of high cost and need for regular maintenance, these models are increasingly being replaced by *Deenbandhu*, a low-cost fixed dome model, in most states. Though *KVIC* model continues to be in the list of models approved for dissemination under NPBD, the number of *KVIC* plants installed in recent years has been very small. During the last few years, even KVIC has been promoting the *Deenbandhu* model. In the hilly areas where the cost of transportation of building material is very high, a new portable model, *FLXI*, is being promoted.

MNES-approved biogas plant models

KVIC Floating Drum
Janata
Deenbandhu
Pragati
Ferro-cement digester
FRP (Fibre Reinforced Plastic) Gas Holder
FLXI Portable Model

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Biogas plants have substantially reduced the dependence on traditional biomass fuels.

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Benefits of biogas

Perhaps the most important benefit of biogas plants has been the improvement in quality of life, especially that of women and children. Biogas plants have substantially reduced the dependence on traditional biomass fuels. In the process, they have managed not only to reduce fuelwood demand, but also eliminated the negative environmental effects such as indoor air pollution, and arrested resource degradation. The smokelessness, time saving and cleanliness offered by biogas have made the technology quite popular with the housewives. And biogas manure has been highly appreciated for its nutritive value by farmers wherever it has been used. In some parts of Gujarat, for instance, biogas is prominently promoted as a soil enricher along with the use as cooking fuel.

While the benefits offered by biogas to the individual households are quite impressive, NPBD has made an impact at the societal level also. The biogas plants installed in the field are estimated to save over Rs 400 crores annually in the form of production of gas equivalent to over 50 lakh tonnes of fuelwood, and 250 lakh tonnes of slurry manure. Apart from these, NPBD has created employment opportunities in the rural areas to the tune of nearly 80 million man-days and provided regular means of livelihood for a large number of unskilled labour, masons and turnkey workers.

Biogas is making a particularly noteworthy contribution in ecologically fragile regions. Gir Lion Sanctuary in Gujarat is an example where biogas technology helped abate the problems of deforestation and fuel scarcity in more than 200 villages in the buffer area to a great extent. This has made a discernible impact on the conservation of wild life in the Sanctuary.

The smokelessness, time saving and cleanliness offered by biogas have made the technology popular with the housewives.

Implementation strategy for NPBD

Funding arrangements

To encourage more people to adopt the technology, a detailed subsidy pattern has been worked out. This subsidy pattern takes into account geographical variations and different categories of people, and varies with plant capacity. Apart from the central subsidy, some of the state governments offer additional subsidy to the biogas beneficiaries. MNES sanctions funds in advance to the state governments/ implementing agencies. Once the targets are finalized for a financial year, 50% of the total estimated outlay is given as advance in the first instalment. The balance 50% is disbursed after completion of 25% of the total physical target and the final settlement for a year is made on the basis of claims sent by the implementing agency for additional target or pending amounts.

However, the entire plant cost is not covered by the subsidy, and soft loans are made available to the beneficiaries to cover the rest of the cost. For this purpose, a lead bank is designated in each state which co-ordinates the loaning activity. Loans are given to the beneficiaries upon fulfilling certain criteria (to set up biogas plants) like minimum number of cattle, space and water availability, etc. At the national level, NABARD (National Bank for Agriculture and Rural Development) offers the scheme of Automatic Refinancing (ARF) to banks for financing biogas plants wherein a fixed proportion of the total amount that is disbursed by commercial banks for installation is reimbursed. Total funds for refinancing for a year is decided at the central level and then distributed among states depending on the target, level of state subsidy, previous year's financing levels, etc. Within each state, the total sum sanctioned is distributed among different branches of banks, one branch usually catering to 20–25 villages. Besides commercial banks, PACs (Primary Agricultural Co-operatives) also finance biogas plants.

Category of Bank	NABARD'S refinancing rate (%)
Commercial banks	70
Rural reconstruction banks State cooperative banks	80
Land development banks	85

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MNES adopted a multi-agency, multi-model appproach to take care of specific needs of specific regions.

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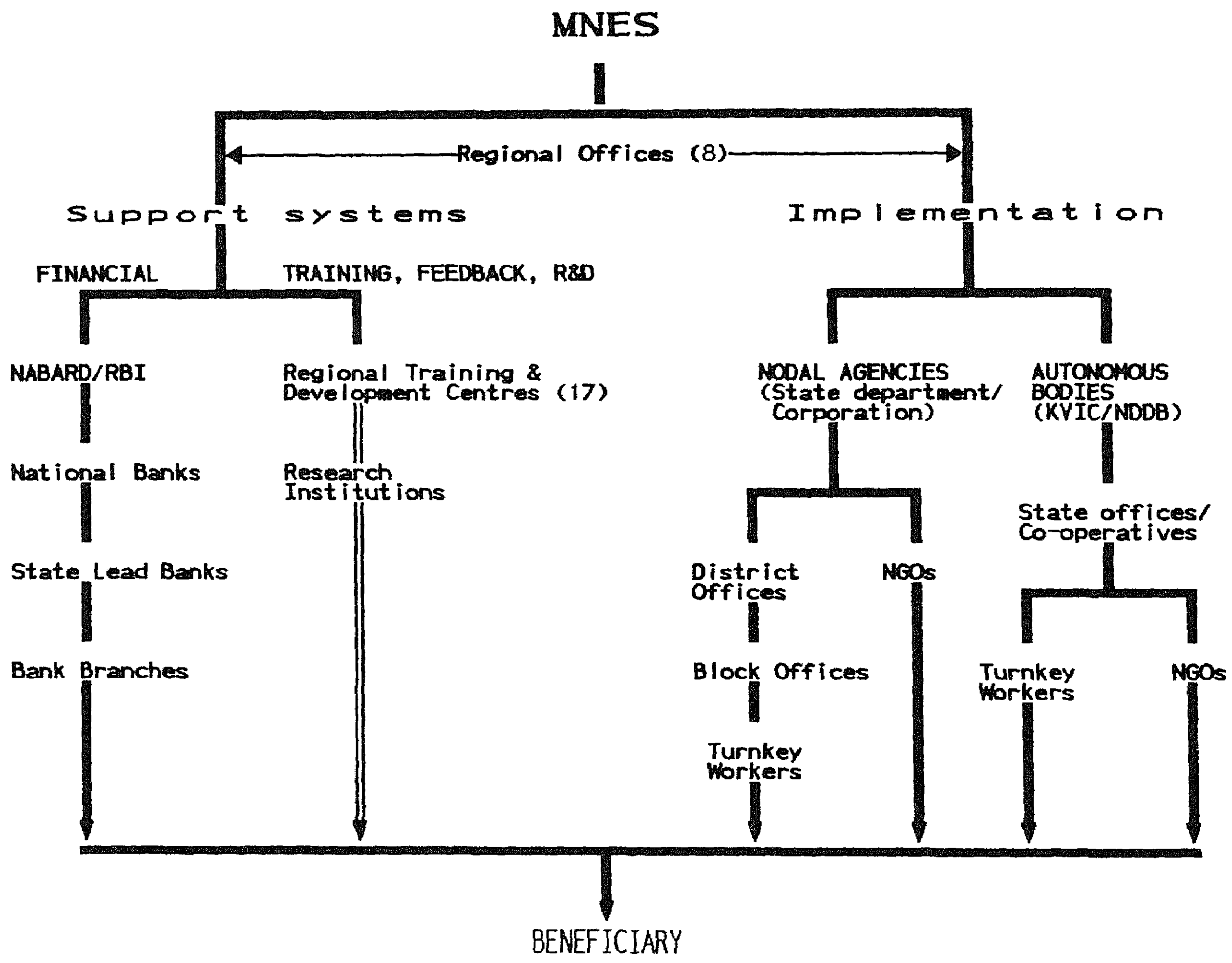
Dissemination process in NPBD

From the very onset, the implementation strategy in NPBD has been kept flexible. MNES adopted a multi-agency, multi-model approach to take care of specific needs of specific regions. State government departments and corporations, societies and NGOs were made part of the programme. In many states, separate energy development agencies exist to run NPBD along with other renewable energy programmes of MNES. Thus at the state level, NPBD is coordinated by a Nodal Department (such as Department of Agriculture, Department of Rural Development or Department of Science and Technology), while the actual implementation is done by a nodal agency (such as Agro Industries Corporation, State Energy Development Agency, or, in some cases, even the government departments like Rural Development or Science and Technology). Within each state, however, one or more implementing agencies could operate under the overall coordination of the Nodal Department. At the district level, the programme is implemented by either DRDA (District Rural Development Agency), or branches of nodal agencies, or/and NGOs, which liaise with the designated national banks for the purpose of providing loans. In addition to the programme implemented by nodal agencies, recognised independent agencies such as KVIC, NDDB (National Dairy Development Board), AIWC

Structure of NPBD



(All India Women's Conference), etc. are given separate targets to be achieved through their own organizational structure.

MNES Regional Offices	
Chandigarh	Lucknow
Bhopal	Madras
Guwahati	Ahmedabad
Hyderabad	Bhubaneshwar

Apart from the agencies that are involved directly in the implementation of NPBD, a large number of other organizations also participate in the programme, providing technical and operational support. Seventeen Regional Biogas Development and Training Centres (RBDTCs) have been set up in different states for conducting R&D work, demonstration of various models, holding different types of training programmes, mounting publicity campaigns, and studying field performance of the installed plants.

In order to provide close guidance to the state nodal agencies, and monitor the progress of the programme, Regional Offices of MNES have been set up in eight states. These offices are assisted in their activities by the respective RBDTCs.

Financial and other incentives

The various financial and other incentives offered to different categories of people under NPBD are presented below:

Subsidy

As mentioned before, a differential pattern of subsidies has been drawn up according to which individual beneficiaries get a fixed sum of money as central subsidy for biogas plant installation. The subsidy pattern is preferential towards certain backward classes of the society like SC, ST, small and marginal farmers, etc. Some notified hilly regions of the country are also entitled to higher subsidies than other states, so as to compensate for the high transportation cost of building material in these areas.

Initially, for plants of most capacities and categories,

Regional Biogas Development and Training Centres

RBDTC	States/UTs covered
AP Agricultural University, Hyderabad	Andhra Pradesh
Assam Agricultural University, Jorhat	Assam and North-eastern States
Rajendra Agricultural University, Pusa Samastipur	Bihar
Gujarat Agricultural University, Anand	Gujarat, Dadra and Nagar Haveli, Daman and Diu
HP Krishi Vishwa Vidyalaya, Palampur	Himachal Pradesh, Jammu & Kashmir, Chandigarh
University of Agricultural Sciences, Bangalore	Karnataka
Kasturbagram Krishi Kshetra, Indore	Madhya Pradesh
Centre of Science for Villages, Wardha	Maharashtra (Marathwada and Vidarbha)
Institute of Renewable Energy, Nasik	Maharashtra (except Marathwada and Vidarbha), Goa
Orissa University of Agriculture and Technology, Bhubaneshwar	Orissa
College of Technology and Agricultural Engineering, Udaipur	Rajasthan, Delhi
TN Agricultural University, Coimbatore	Tamil Nadu, Pondicherry, Lakshadweep
Regional Institute of Rural Development, Ghazipur; Gurukul Kangri (sub-centre of RIRD), Haridwar	Uttar Pradesh
Indian Institute of Technology, Kharagpur	West Bengal, Andaman and Nicobar Islands
Department of Agriculture, Thiruvananthapuram	Kerala
Haryana Agricultural University, Hissar	Haryana
Punjab Agricultural University, Ludhiana	Punjab

the subsidy amount covered over 50% of the capital cost of the plant. However, the subsidy pattern kept changing over years, with amounts declining, as the biogas plants achieved greater acceptability. Also, the subsidy, which used to be given for plant sizes ranging from 1 to 10 m^3, has now been confined to 1 to 4 m^3 to encourage better capacity utilization.

Turnkey fee

A fee of Rs 500 is paid to TKW (turnkey worker) for every biogas plant constructed on a turnkey basis including a three years warranty for trouble-free functioning of the plant. It may be mentioned here that only corporate bodies, recognized registered societies, voluntary organizations and approved entrepreneurs are eligible for the turnkey job fee. During the warranty period, TKW has to repair, at his cost, any defect not attributed to improper handling by the beneficiary. In case of structural defects, TKW has to even replace/reconstruct the plant at his own expense. In case of other minor operational defects, the beneficiary has to bear the cost of repair.

For sanitary toilet linked biogas plants, an additional turnkey job fee of Rs 150 per plant will be paid against a 2–year warranty. But, the implementing agencies have the option to claim the additional subsidy for payment to beneficiaries for such plants.

Subsidy pattern under NPBD (*amount in rupees*)

Capacity of plant (m^3/day)	NE region states excluding plains of Assam, Sikkim, J&K, HP and 8 hilly districts of UP (excluding terai regions of two hilly districts), A&N Islands, Lakshadweep	SC/ST, desert districts, small and marginal farmers, landless labourers, plain areas of Assam, terai regions of two hilly districts of UP, Western Ghats and other notified hilly areas	All others
1	2800	2000	1500
2	3200	2400	1800
3 & 4	3500	2600	2000

Promotional incentive

A promotional fee to village level functionaries or approved workers of KVIC institutions is paid at Rs 50 per plant actually supervised.

Service charges/staff support

The state nodal agencies and other implementing agencies are paid service charges to support their staff. These charges are given only to implementing agencies having a target of more than a thousand plants.

Target range (no. of plants)	Amount of service charges
100–999	Rs 35000 + Rs 250 per plant in excess of 100 plants
1000–3000	Rs 5 lacs + Rs 150 per plant in excess of 1500 plants
3001–7000	Rs 7.5 lacs + Rs 100 per plant in excess of 3000 plants
7001–20000	Rs 11.5 lacs + Rs 75 per plant in excess of 7000 plants
Above 20000	Rs 21.5 lacs + Rs 50 per plant in excess of 20000 plants

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The flexibility maintained in a multi-agency, multi-model strategy has been the strength of NPBD.

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Incentive for saving diesel from biogas

A subsidy up to 50% of the total cost, with a maximum ceiling of Rs 2500, to convert diesel engine into dual-fuel engine to be run on a combination of biogas and diesel, will be paid under NPBD. This cost includes that of technical kit for conversion, and of 3 to 4 m^3 capacity plastic/rubber balloons/container to store and transport biogas from the plant site to the engine site.

Training courses

In addition to funds for implementation, separate grants are sanctioned to state governments/ implementing agencies to conduct training courses for users, turnkey workers/masons and for representatives of governmental and non-governmental organizations. The courses are organized by the implementing agencies in collaboration with RBDTCs and the Regional Offices of MNES. At the beginning of every financial year, state-wise, agency-wise and RBDTC-wise annual targets are given for training courses to be conducted during the year, and funds disbursed in advance for the same. The respective bodies can send their demands to MNES for additional targets, if necessary. For all training courses, financial assistance is provided by MNES. Apart from these training courses, AFPRO also organises training to a group of NGOs who are participating in NPBD. There are 68 such NGOs at present as part of the AFPRO network.

Assistance for training courses	
Category of training	**Amount**
Users course	Rs 5 per plant
For staff of governmental agencies and NGOs incl. women organisations, change agents, etc.	Rs 5 per plant
Refresher/construction-cum-maintenance courses/trainers' training courses	Rs 9000 per programme
Training of turnkey workers/agencies	Rs 30 000 per programme

Communication and publicity

Awareness generation for biogas is undertaken both by the centre and the state nodal agencies. Under this a variety of means are used like advertisement on radio, television, print media, folk art forms, fairs and exhibitions. The financial assistance for publicity to the state implementing agencies is linked directly to the target range.

Target	Publicity fund
1000	Rs 100 000
1000–10 000	Rs 250 000
> 10 000	Rs 500 000

Performance awards

Apart from financial assistance in the above forms, cash awards were also given to states and districts for outstanding performance in different categories. From 1993–94, it has been decided to present the awards in the form of gold and silver trophies instead of cash.

Monitoring process

Once the plants are actually installed in the field, it is important to receive reliable feedback on the operational aspects so that the implementation process can be continually improvised. Keeping this in view, MNES has created feedback mechanisms at various levels involving various categories of people. The salient features of the monitoring process are presented below:

Physical verification

In order to receive the subsidy amount from MNES, the respective state governments (Nodal Departments) send in claims on biogas plants actually commissioned on a monthly basis, after physically verifying them. So as to ensure that incorrect reporting is not done from the ground level, the Block Level Officer is expected to verify 100% plants, District Level Officer 5–10%, and State Level Officer 1–5% of the plants.

The state governments and implementing agencies have the mandate to make serious efforts to identify the dysfunctional plants and have them rectified, by, if necessary, organising special training and refresher courses for users and staff. A quarterly report on the status of revival of dysfunctional plants is submitted to MNES.

Field inspections

The Regional Offices of MNES have the responsibility of surveying 100% plants in a block of a district selected on a random basis. RBDTCs have similar targets for inspection. Nodal Departments, Agencies, KVIC, etc., provide requisite assistance in carrying out these inspections.

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The state governments and implementing agencies have the mandate to make serious efforts to identify dysfunctional plants and rectify them.

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Feedback and follow-up

An effective system for collecting information, providing feedback and carrying out performance monitoring, has been devised involving TKWs, field functionaries, and officers of the nodal agencies at block, district and state level, so as to ensure quick remedial action for improving the functionality. Apart from this, the officers of MNES headquarters as well as Regional Offices also carry out random sample inspections to study the operational performance of the plants and suggest improvement measures.

In addition to the surveys thus conducted by various officials directly involved in NPBD, independent research and academic organisations are commissioned by MNES periodically to carry out evaluation studies and specific case studies to receive feedback on the functionality, reasons for failure/

success, local requirements to improve the performance, etc.

Effectiveness of the implementation strategy

The flexibility maintained in a multi-agency, multi-model strategy has been the strength of NPBD. This has facilitated various organizations to evolve different approaches to implementation so as to adapt themselves to the specificity of local conditions. For instance, in Orissa, NGOs have been given a greater role in implementing the programme; Andhra Pradesh has adopted a single-size, single-model strategy as a policy; and KVIC operates all over the country through a cadre of trained mechanics to regularly monitor the biogas plant performance. However, the factor that emerges as the most important contributor to the success of the implementation strategy is the turnkey approach promoted in NPBD. Though it has been an integral part of the implementation strategy in NPBD right from the beginning, the turnkey approach has taken deep roots only in recent years, and has attracted diverse groups of people such as NGOs, private entrepreneurs, etc. into the fold of the biogas programme.

Biogas plants in some districts of Andhra Pradesh have been found to enjoy a functionality rate in excess of 95%.

Turnkey approach—the success story

Though implementing agencies adopt different approaches, most of them operate through a network of TKWs (turnkey workers), who install biogas plants for the beneficiaries on a turnkey basis. TKW plays a crucial role in the whole set up as he/she works at the village level and provides the essential link between the implementing agency and the beneficiary. In fact, in most states, TKW is the only person in the entire NPBD structure the beneficiary comes in direct contact with throughout the installation process.

Though the profile of a turnkey worker varies across the country, a typical turnkey worker operates in a cluster of villages and is involved in the entire process of biogas plant installation. This includes identifying and motivating the beneficiary, helping to get the subsidy and loan sanctioned, getting the plant constructed and commissioned, and ensuring trouble-free performance for a period of three years.

In order to be eligible for receiving the turnkey fee, TKWs have to register themselves with the implementing agency at the district level (DRDA, Energy Development Agency, Agro-industries Corporation, etc.), and also undergo a basic construction-cum-maintenance training course conducted by the implementing agency with assistance from the respective RBDTCs.

Besides village masons, turnkey jobs may also be undertaken by rural entrepreneurs and NGOs. A number of NGOs across the country have taken up the role of turnkey organisations for the state nodal agencies—some of the major examples are Aga Khan Rural Support Programme (AKRSP) in Gujarat, MYRADA in Karnataka, and Gram Vikas in Orissa. Such organisations are entitled to get the turnkey job fee from MNES and this is further passed on to their supervisors and masons who actually perform the construction work. In some areas entrepreneurs who manufacture stoves and other such accessories of biogas plants have also ventured into installation of biogas plants on a turnkey basis. Thus, the profile of a TKW varies from a farmer to a mason to an accessory manufacturer.

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Women have come forward to become turnkey workers in some parts of the country.

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The prime advantage of the TKW system has been that of quality control. Since the release of the turnkey fee to the TKW has been made contingent upon maintaining the plant problem-free for three years after commissioning, TKWs have a direct stake in ensuring proper construction and use of good quality building material. This has improved the functionality rate quite dramatically in many places. For example, biogas plants in some districts of Andhra Pradesh have been found to enjoy a functionality rate in excess of 95%.

Also, since TKW is involved in all stages of plant installation, it is possible to gain the confidence of beneficiaries to ensure their complete co-operation, which is critical to the success of the programme. Especially, illiterate farmers find this arrangement beneficial as TKW can follow up on subsidy, liaise with bank officials, and so on.

Given these factors, the turnkey approach has gained momentum in many states like Maharashtra, Gujarat, Andhra Pradesh, Tamil Nadu and Orissa. Considering that these are the states where NPBD has been performing exceptionally well, it is clear that TKW has become the mainstay of NPBD — MNES now encourages the state nodal agencies to meet 75% of their target through turnkey workers, whether they are NGOs, registered societies or entrepreneurs. In fact, this is so much so that even women have come forward to become turnkey workers in some parts of the country in a welcoming trend. For instance, Kasturbagram Krishi Kshetra, Indore has successfully motivated a large number of tribal women in Jhabua district of Madhya Pradesh to adopt the biogas technology and trained them in plant construction. Some of these women have now become self-reliant by taking up turnkey installation of biogas plants as a commercial venture. There are a large number of women entrepreneurs operating in Tamil Nadu also, trained by the RBDTC at the TN Agricultural University, Coimbatore.

The success of the turnkey approach is also evident in the role a few NGOs are playing in the implementation of NPBD at the grassroots level. Some NGOs have also been involved at the state level, in coordinating the dissemination activities along with government agencies like DRDA at district level and BDOs at block level — MYRADA in Karnataka, Gram Vikas in Orissa, Grama Siri in Andhra Pradesh are some examples of such NGOs which have taken up biogas programme as a major activity.

■

NGOs have adopted innovative strategies to promote the technology.

■

The available feedback on the performance of NGOs in disseminating the biogas programme suggests that they have, given their proximity and good rapport with the common people, been quite effective in implementing the turnkey approach in all its aspects right from motivating the potential beneficiaries, assisting them in procuring subsidies and loans, installing the plant and finally providing follow-up services.

In some places, NGOs have attempted innovative ways to promote the biogas technology. For instance, AKRSP in Gujarat, has devised different strategies for areas with different local conditions — in Surendranagar district which has a very poor quality soil, biogas is being promoted as a technology for enriched manure, while in Bharuch where fuelwood collection is the single-most important problem faced by women, it is projected as a fuelwood saving technology.

Thus, on the whole, the performance of various categories of TKWs has been easily one of the highlights of NPBD. Interestingly, while TKWs seem to have done a great service in spreading the plants successfully, NPBD, too, in turn, has helped many turnkey operators, in earning a regular livelihood. Some NGOs have also been able to establish themselves primarily because of their involvement in the biogas programme. For instance, the Vaishali Area Small Farmers' Association (VASFA), an NGO in Muzaffarpur district of Bihar, was on the verge of closing down in 1986, due to problems in repayment of loans in its other projects when they took up the biogas programme. Once they took it up, it gave them much needed financial security and a purpose to serve the local needs.

The multi-model, multi-agency — and it can be added, multi-strategy — approach adopted under NPBD has paid dividends in implementing the programme effectively. In order to illustrate the efficacy of such an approach, the implementing strategies of two specific agencies, Gujarat Agro-Industries Corporation (GAIC) at the state level, and KVIC operating at the national level, are examined here in detail.

> *"Biogas programme gave Gram Vikas respect, clout and visibility. It is today recognized as an agency which can be depended upon.."*
>
> Joe Mediath
> *Gram Vikas*

Gujarat Agro Industries Corporation (GAIC)

Gujarat is one state in which the biogas programme is implemented by many agencies like KVIC, NDDB, AKRSP, GAIC, etc. with overall coordination by the state Nodal Department. The most prominent among them is GAIC, which is the nodal agency for Gujarat. The involvement of GAIC in biogas dissemination started long before NPBD was formally launched. GAIC was set up with the objective of distribution and marketing of various agricultural inputs like tractors, spare parts, fertilizers and farm implements. For these, it developed an infrastructure of district level Agro Service Centres (ASCs) and Technician Centres. Using the same organizational set up, GAIC started installing biogas plants in 1976. However, prior to 1981, biogas programme formed only a small fraction of GAIC's overall span of activities. After NPBD was launched and GAIC designated as the state nodal agency, it set up a separate energy division with field level arrangements for execution of the programme. Specifically, GAIC performs the following functions under its biogas programme.

- Procurement, storage and distribution of construction material, and other inputs required for biogas plants
- Receipt and disbursement of subsidy to beneficiaries
- Training of masons, supervisors, motivators and users, and also arranging grants and assistance for the same
- Arranging institutional financing
- Publicity and promotion of biogas programme
- Post-installation repair and maintenance of biogas plants
- Coordination with programme implementing agencies at state level

GAIC currently is operating in over a hundred blocks in Gujarat, selected on the basis of the existing GAIC infrastructure as well as the potential of the area. In actual installation, a cluster approach has been adopted; GAIC insists that a minimum of six plants be constructed at a time and efforts are made to install the maximum number in the immediate vicinity before another village is taken up for implementation. This approach makes it more convenient and economical for providing supervision and repair and maintenance services. However, if an area with exceptionally high potential is identified, it may be taken up on a priority basis.

As mentioned before, GAIC implements the programme through its ASCs where there is an in-charge for biogas programme. At the block/village level, GAIC selects and trains unemployed, educated youth to turn them into SEBGSs (Self Employed Bio Gas Supervisor), who supervise the construction of biogas plants. These SEBGSs are not employees of GAIC but work under the guidance and supervision of GAIC staff at the ASCs. To ensure good quality construction, an individual supervisor is allowed to oversee the construction of a maximum of 100 to 200 plants annually.

With regard to the financing of plants, besides the central government subsidy, the state government also provides a subsidy to encourage setting up of biogas plants. These cover a substantial part of the plant cost, but the beneficiary still has to contribute a minimum of Rs 1500. Though bank loans are available, GAIC encourages beneficiaries to provide the contribution by themselves. Apart from avoiding procedural delays, this practice ensures that the beneficiary has a stake in his plant.

Funding for GAIC biogas plants				
	Year	1986–87	1987–88	1988–89
Without Bank Loan	No.	10237	9482	12719
	% of Total	70.40	83.00	89.40
With Bank Loan	No.	4297	1975	1502
	% of Total	29.60	17.00	10.60
Total		14534	11657	14221

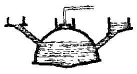
The dependence on bank finance in Gujarat has been low for two reasons: (i) GAIC has adopted a single model approach wherein only the fixed dome *Deenbandhu* model is promoted, and (ii) a part of the subsidy is paid by GAIC in the form of building materials. As materials are made available before the construction begins, the need for external financing reduces.

Stages in implementation

Awareness building and motivation. Like in other states, in Gujarat also village level workers (VLWs) or other government functionaries are responsible for creating awareness. But they are known as Promoters in Gujarat, who are selected and trained by GAIC, and normally operate in an area of 20–25 villages. They not only explain the advantages of biogas technology to potential beneficiaries, but also coordinate with SEBGSs throughout the construction period. Some selected Promoters are also trained to carry out minor repair work of the plants. They are paid a promotional incentive of Rs 50 for every plant installed with their involvement.

Construction. Once the beneficiary agrees to get a plant installed, the Promoter introduces him to the SEBGS. This is followed by collection of preliminary information (a form has to be filled) which is then sent to the state nodal agency for approval. After these formalities are completed, size and site of the plant are decided by SEBGS in consultation with the beneficiary and the ASC staff. The construction work is carried out by trained masons. Most of the masons are attached to particular NGOs/SEBGSs. They are engaged on a daily wage basis and on an average one mason can construct 25–30 plants in a year. The SEBGSs are solely responsible for the construction of the plant from giving the dimensions for the pit to the commissioning of the plant. The building material and accessories such as cement, pipe fittings, stoves, and lamps are supplied from the district ASCs. Thus, a part of the subsidy is paid in the form of building material.

SEBGS is paid a fee of Rs 300 for every plant constructed and for which he has to ensure trouble-free functioning of the plant for three years after installation. In case of defective material provided by GAIC, the same is replaced by GAIC but the faults in construction are rectified by SEBGS. After the plant starts operating, the ASC staff visits the site, and issues a completion certificate. This certificate is essential for releasing the remaining part of the subsidy.



Post installation repair and service. During the three-year warranty period, it is obligatory for the SEBGS to visit each plant at least once in six months even if the plant is functional. As the plants are installed in clusters, the task is simpler for the SEBGS than it would have been otherwise. Apart from this, every year the district staff inspects all the plants installed. The GAIC headquarters also conducts a random survey of 25% of plants set up during the year.

To a certain extent the beneficiary also monitors the plant's functioning. GAIC gives every beneficiary a booklet containing detailed instructions on construction and operation. He is also given two postcards to be addressed to the local SEBGS in case of any problem. Further, each constructed plant has a specific code engraved on it giving the year of construction, serial number of SEBGS and serial number of the subsidy register maintained at the ASCs. This number helps to identify the plants in case any repair work is required.

To ensure an efficient repair service, GAIC has promoted a number of mobile motor cycle units. These units are set up at the district level and are manned by trained personnel.

Project record

The performance record of the NPBD in Gujarat exhibits a phenomenal progress over the years. As against a total of 11 800 plants set up till 1980–81, the late eighties saw nearly 10 000 plants being installed every year, and a target of 38 000 for 1992–93. Gujarat is also one of the states where the functionality rate of plants has been high, where 88% of the plants commissioned during 1985–90 were found to be operating successfully.

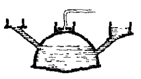
Apart from the quantitative indicators of success of the project, biogas has helped in numerous other ways. Removal of the drudgery of fuel collection, elimination of smoke and soot in the kitchens, more time on hand for the housewives, and regulated supply of cooking fuel have been greatly appreciated by the women. Realizing that the benefits accrue primarily to them, a greater number of women are now taking initiative to handle the plants themselves. Certain other benefits that cannot be quantified but stretch beyond economics are:

1. time saving in collecting fuelwood and making dung–cakes,
2. better sanitation resulting from absence of animal dung lying around in the village,
3. less weeding required as the grass seeds in the dung get decomposed during digestion of slurry which can be used as manure, and
4. more usable space as fuelwood and dung–cakes need not be stored.

The strengths of the biogas programme as well as factors external to the project contributing to good performance are

1. **Programme–organization fit.** Even before the launching of the biogas programme, GAIC was involved in the distribution and marketing of agricultural inputs through its district level ASCs. Because of the established network of manpower and infrastructure, the biogas programme could utilize the existing resources, and hence additional cost to the organization was not substantial. Apart from the cost factor, as the villagers were already familiar with the organization, the task of awareness building and motivation for the biogas programme became simpler.

2. **Cluster approach.** GAIC, while implementing the programme, adopted the method of constructing plants in clusters of villages. This has facilitated economies of scale, better quality control and follow–up activities. This approach has resulted in time saving in project execution and reduced cost of transportation as larger quantities of building material can be transported at a time. Thus, at the end of 1991, there were 628 villages with more than 25 biogas plants each, 227 with more than 50 plants, and 45 with over 100 plants. There were also some villages which had a few hundred operational plants.
3. **Quality control of material.** Standard building materials manufactured by reputed companies are supplied from the ASCs helping in cost saving for GAIC as material could be procured in bulk, ensuring even quality of material, and timely delivery during construction.
4. **Close monitoring and evaluation.** GAIC has stipulated that the number of plants constructed by an individual SEBGS in a year be restricted to a maximum of 100–200 so as to prevent dilution of quality of work. Quality becomes important as it has been observed that a well constructed plant can serve up to twenty years with no major repair work. A tight control from the authorities also ensures better accountability to the beneficiaries. Other means such as routine inspections, mobile motorcycle units, and post card surveys, are also employed to monitor the functioning of the SEBGSs.
5. **Motivation at all levels.** Because of the monetary incentives provided, there is a direct motivation to produce results at all levels, under the biogas programme.



- For GAIC as an organization the biogas programme fits in its range of activities, and at the same time strengthens its marketing and distribution infrastructure. GAIC also gets a service charge of Rs 175 for every plant constructed.
- An SEBGS gets Rs 300 per every plant he installs. Thus, his annual income can vary from Rs 30 000 to Rs 60 000 depending on the number of plants he installs.
- The unemployed youth who act as Promoters get Rs 50 per plant as motivation fee.

- The masons earn between Rs 300 and Rs 400 per one installed plant.

Thus, using a highly professional approach, GAIC has been able to turn Gujarat into probably the most successful state in promoting biogas in the rural areas.

Khadi and Village Industries Commission (KVIC)

KVIC has been a pioneer in the dissemination of biogas plants in India. It has been in the field since 1962, much before the advent of NPBD. Realizing the need for technological research and development in biogas at that time, KVIC set up a separate R&D wing and developed standard designs for plants of varying capacities. These designs were installed in different parts of the country and closely monitored. Five Regional Centres were also set up at Gandhigram in Tamil Nadu, Khadasli in Gujarat, Manesbal in Jammu & Kashmir, Allahabad in Uttar Pradesh and Nasik in Maharashtra to evaluate the performance of their plants. Because of the limited scale of the programme, each and every plant could be personally supervised which in turn ensured high functionality rate of the plants. As the plant costs were high, KVIC had to arrange for subsidies and interest free loans for its beneficiaries. Between 1962 and 1974, KVIC installed nearly 7000 plants in the country.

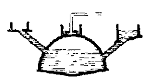
When NPBD was launched in 1981, KVIC with its long experience in the field provided technical expertise to the programme and also helped to train the personnel of other implementing agencies. Right from the inception of the biogas programme, KVIC has been an integral part and is allotted separate targets over and above the targets given to respective states/UTs.

The total annual target given to KVIC, is divided into targets for each state, by the KVIC head office at Bombay. However, before the end of each financial year, the state offices are invited to propose targets for the coming year. Ultimately, it is KVIC's overall target and the past performance of the states, that determine the state-wise distribution of the target. At the lower level, district targets are decided in consultation with the field staff. The yearly targets are further divided into quarterly targets. Normally, a major proportion of the target (sometimes more than half) is fulfilled in the last quarter, which is the general trend in NPBD. For instance, in 1991–92, out of 600 plants installed in Gujarat by KVIC, 87.5% were during the period of January to March; in 1990–91, 75% of the plants were similarly installed in the last quarter. In some cases, because targets have to be completed by the year end, work on a large number of plants is just initiated before the end of March so that they can be included in that year's achievement. This work spills over to the next 2–3 months and consequently the work for the next year gets delayed and the first few months show negligible progress.

Details of operations

As KVIC is an autonomous institution, it has been able to adopt an implementing strategy that is fairly flexible and different from most other government agencies. The Gandhian thought that has been the driving force behind the Khadi move-ment has also conditioned the functioning of the organization.

Like most other implementing agencies, KVIC also operates through a network of turnkey workers, who are not KVIC employees. Though KVIC does monitor their functioning, the real monitoring comes from beneficiaries themselves. In Maharashtra and Gujarat, where turnkey installation of biogas plants is a profitable venture, the turnkey workers make conscious efforts to keep the beneficiaries satisfied. A TKW, who on an average installs 300–400 plants in a year has to ensure good post-installation service if he/she is to motivate more villagers to build biogas plants.



Awareness building and motivation. The task of motivating beneficiaries to construct biogas plants is usually undertaken by the turnkey workers themselves, or they engage unemployed youth in villages at a small fee on a per plant basis. In high potential areas, they are employed on a regular monthly stipend of Rs 200–300. Often, these persons are responsible not only for promotion but also act as assistants through out the construction work looking after all odd jobs like guiding the beneficiaries during pit digging, procurement of building material, etc. As individuals are not eligible for MNES' promotional incentive of Rs 50 per plant, turnkey workers often attach themselves to registered organizations/associations in order to avail this fee.

Construction. Once the beneficiary has agreed to install a plant, a questionnaire with details like number of cattle owned, loan required or not, etc., is filled by TKW for the beneficiary and submitted to the state KVIC office for approval. If a loan is required, the papers are sent to the local bank for sanction, and the construction of the plant starts as soon as the loan is sanctioned. However, KVIC encourages the beneficiaries, where possible, to go in for self-financing. In the KVIC set up, the initial investment for the building materials is made by the turnkey worker. For this reason, a minimum capital base becomes an informal eligibility criterion to become a turnkey worker. In most states, turnkey workers enter into short term credit arrangements with local material suppliers. In some places like district Kolhapur in Maharashtra, the turnkey workers have shown considerable initiative by coming together and forming an Association. This Association purchases material in bulk which brings down the cost substantially. It is also planning to standardize the quality as well as prices of accessories for biogas plants.

TKW can send a subsidy claim for a plant only after a completion certificate has been issued by the KVIC supervisor. The final disbursement of the subsidy which is made to TKW takes two to three months time after the plant construction.

Post installation maintenance and service. After commissioning the plant, the turnkey worker is responsible for proper functioning of the plant during the warranty period. It is interesting to note that once the plant construction is over, KVIC is not accountable to individual beneficiaries in any way. The sole responsibility of the plant lies with the turnkey worker. However, since the job is viewed as a business proposition by the turnkey workers, it is important for them to keep their customers happy which ensures a good post installation service in most cases.

Though the responsibility for repair and maintenance does not lie with KVIC, the importance of the same has been recognized by them. In order to ensure a systematic procedure to attend to the plants already installed, KVIC has launched the PIRM (Post Installation Routine Maintenance) scheme. This scheme covers all plants for a period of three years after the completion of the 2–year warranty period, thus ensuring that each plant is monitored at least for a period of five years. The scheme is carried out by a cadre of Trained Mechanics (TM) of KVIC who are expected to visit each plant in their area at least three times in a year. TMs are provided with a handy tool kit to attend to minor repair works.

The PIRM scheme of KVIC which was launched in 1989–90 is confined only to a few states and not yet introduced in all the states. However, in states like Gujarat and Maharashtra where biogas adoption is in an advanced stage, the PIRM is functioning very well.

Monitoring and evaluation. As mentioned before, the monitoring comes from the beneficiaries themselves. In addition to this, KVIC also carries out random surveys of the plants installed by a TKW before the supervision charges are paid to him. As far as annual surveys are concerned, they are of two types:

1. Random survey of 10% of the total number of plants installed in a district.
2. 100% survey of a block which has at least 5% of the total number of plants installed in a district.

Thus, the main features of the implementation strategy of KVIC, which have enhanced the effectiveness of the programme are: a decentralized approach; considerable autonomy to turnkey workers; and turnkey job being encouraged as a business enterprise.

The lessons of implementation strategy

Most of the evaluation studies conducted on the performance of the biogas plants have shown that a majority of the failures reported under NPBD are due to minor structural and operational problems, and lack of quality control in construction. These observations are particularly relevant in the case of *Deenbandhu* plants which require higher order engineering skills to ensure foolproof construction.

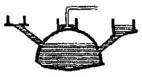
However, these evaluation studies have also indicated that such problems could easily be rectified by the implementing agencies through proper training and user education. Thus, institutional aspects such as creation and development of adequate manpower and requisite infrastructure at the local level to take care of these functions, come out to be the key to ensure continuing success of the biogas programme. NPBD already has special provisions and financial allocations to carry out these programmes, and, indeed, the most successful dissemination programmes in Gujarat, Orissa, and Maharashtra, owe their success to these aspects. However, as illustrated by examples, it is the operational flexibility and improvisation adopted by the implementing agencies to suit the local conditions which would guarantee the success of the programme. Therefore, it is imperative to take proper feedback on the positive aspects of the implementation strategies of successful examples to be followed in other parts of the country so as to strengthen the dissemination efforts at the national level.

The new strategy in NPBD

In line with the new economic policy ushered in the country, MNES has also initiated several fundamental changes in the promotion of renewable energy technologies, with basic thrust on commercialization, and NPBD has been no exception. In the new scheme, the role of the beneficiaries has been enhanced substantially by progressively reducing the subsidy component, which would be abolished in totality from 1995–96. In order to impart necessary market orientation for the programme, publicity and awareness campaigns using multi-media forms are also being taken up on a major scale. On the operational side, procedures for release of funds for various components of NPBD are being simplified to ensure timeliness in completion of targets. In view of these important developments, the targets of biogas plants have been revised upwards; the target for 1993–94 is now 200 000 as against the earlier 135 000, and the Eighth Plan target is 1 000 000 instead of 700 000.

Thus, the measures being introduced in the new strategy appear to be a logical culmination of the wide and varied experience gained in more than a decade of implementation of NPBD. For instance, it has been well established that the biogas programme has achieved such a level of success in particular areas, that people in these areas are prepared to install and accept biogas plants investing their own funds, without any institutional support. Thus, it makes eminent sense to identify areas with similar conditions and push for market orientation to promote biogas plants commercially.

The fact that TKWs including private entrepreneurs and NGOs have had a major role in the success of NPBD is well recognized in the new strategy which envisages to meet a major proportion of the target through these two categories. From now on, 75% of the total target of biogas plant installation is proposed to be achieved through turnkey workers and voluntary organizations (NGOs). Such a move would not only create wide employment opportunities in the rural areas, but the spread of biogas technology on a large scale is also likely to spur development of other income-generating activities like small-scale industries. And once a major part of the actual implementation is handled by TKWs and NGOs, the government agencies at various levels will be able to concentrate on other aspects towards improvement of the programme, namely monitoring, and support activities such as training and R&D. Strengthening the support structure of NPBD would go a long way in the overall performance of the projects. Thus, the future is extremely encouraging for biogas technology, which is poised to realise its immense potential to meet the burgeoning energy needs of the rural areas.



General guidelines for implementing agencies

As discussed earlier, the multi-agency approach of NPBD has resulted in development of effective implementation strategies. The experience has also provided valuable lessons to be followed in the future. The essence of this experience has been used to present here, a general set of guidelines that can be used by implementing agencies while planning the installation of biogas plants in their respective areas.

Designing a biogas dissemination programme

An extension programme for any technology can be carried out in two phases—demonstration and large-scale dissemination. During the demonstration, the technology is introduced on a pilot scale and is closely monitored for its field performance and appropriateness. Potential for the technology is also assessed simultaneously vis-a-vis socio-economic and resource considerations. Such a pilot project would also lead to identification of various operational constraints likely to be faced. Thus, feedback from the demonstration phase would become necessary to be taken into account before substantial resources are committed to a large intervention programme. Biogas technology is no exception to this process. Before taking up dissemination on a large scale, it is necessary to develop local skills and establish an infrastructure in order to ensure the quality of work during biogas plant installation and facilitate field activities. Providing training for people at various levels is one of the important functions in this regard.

For the successful implementation of biogas programme, it is important to take into consideration, area specific factors. A complete biogas dissemination programme involves the following activities.

a. Pre-installation activities—motivation, selection of beneficiaries, determining the capacity and type of biogas plant, arranging for loans and subsidies
b. Construction and commissioning
c. Post-installation services
d. Impact assessment

Thus for a successful dissemination programme, appropriate training has to be imparted to different categories of people—turnkey workers, government staff, masons, and beneficiaries.

Since a TKW has to be responsible for the entire dissemination programme, he must be trained in all the activities mentioned above. The staff of implementing agencies also need training to carry out their functions of monitoring and feedback. Masons have to be provided training mainly in construction. However, a mason can also be trained in other activities to carry out the functions of a TKW. Training to plant owners mainly includes instructions for plant operation and maintenance.

It must be noted here that a training programme can be conducted in an area only if there are potential trainees among the local population. Also, the need for a demonstration phase arises only in the areas, where the technology has to be introduced anew. If the presence of biogas is already established, as is the case with most parts of the country by now, direct intervention programme on a large scale could be taken up, after assessing the potential.

Assessment of potential

In order to devise an effective implementation strategy including manpower and infrastructural requirements, it is necessary to arrive at a realistic assessment of the potential in terms of number of biogas plants that can be installed in a village or cluster of villages. For this purpose, a primary survey needs to be carried out. This survey could be conducted with a structured questionnaire which would cover information at village and household level (two schedules) on the following aspects

- The domestic energy use pattern in the select geographical unit
- Cattle owning pattern at the household level so as to determine the number of families with sufficient cattle to install a biogas plant. This could also include information on the pattern of sale and purchase of cattle heads to determine the population for which plant size can be decided.
- Whether the cattle are open-grazed or stall-fed, dung collection efficiency, etc.
- Availability of regular supply of water, and space for biogas plant construction

- Level of awareness about the technology and willingness to own a plant so as to decide the scope of the programme in terms of number of biogas plants to be installed
- Credit-worthiness of willing households as bank loans will not be extended to defaulters

In order to increase the level of awareness, a write up on information about technology may be given to each household at the time of conducting the survey. This should include information on the advantages and uses of the technology, financial details of plant installation and these also have to be explained to them verbally.

However, the need for a detailed feasibility study will depend on the scale of the intervention in a particular region. If it is not a large programme, then a much simplified and rapid feasibility survey that gathers essential information in terms of availability of dung, water and space will suffice.

Training programmes

Usually, if biogas programme has already been implemented in the region, there exists a work force in the form of masons and/or turnkey workers which could be utilized for expansion of the programme. However, if the area is new, it is necessary to develop such a work force, preferably from the local population. For instance, unemployed or partially-employed people could be motivated to take up the role of turnkey workers; and the masons involved in other construction works could be encouraged to take up biogas construction. And the strength of such work force would be governed by the scope of the project. Once people for the specific roles are identified, they should be provided requisite training. These courses are normally designed and conducted by the implementing agencies with the assistance of RBDTCs of respective states. And once the plants are constructed and commissioned, it would be necessary to educate the users on the aspects of operation and maintenance to ensure smooth functioning.

For a biogas training programme to be effective, it is essential to have some training material which can facilitate the process of learning. Thus, once the decision is taken to implement the programme, the relevant material has to be prepared. It may be noted that the training material should be prepared in the local language to act as a guide for extension workers, masons and users. For different biogas plant designs, detailed construction manuals are available and could be used in the curriculum of the training programmes. These manuals cover the basics of the biogas technology; details about the pre-installation activities such as selection of households, selection of the right capacity of the plant, procedures for obtaining loan and subsidy, material procurement, and a step-wise procedure for construction right from the site selection to commissioning of the plant. In terms of trainers who provide training, it is desirable to have people who have considerable experience in field dissemination and at the same time understand the conceptual aspects of the technology as they would be able to appreciate better the dynamic variations that occur in the field due to local conditions.

TKW training. Since TKWs are expected to be involved in every step of the dissemination activity, their training requirements are quite comprehensive covering the following aspects:

1. *Selection of potential households.* This activity includes the final selection of the households for plant construction. The households have to be selected from the ones who had shown interest in installing a plant during the survey. Selection of households will depend on (a) sufficient supply of dung and water to install a plant of requisite capacity, (b) space availability for plant construction at the place of residence, (c) existence of proper kitchen where the plant is to be constructed, and (d) confirmation from the bank that the household can get loan.
2. *Obtaining financial assistance.* Depending on the coordinating agency for NPBD at the district level, the procedure for sanctioning loans and subsidies would vary. Therefore, it is necessary to explain the procedures of obtaining details from beneficiaries, applying, following up, and liaising with bank officials, as part of the training.
3. *Procurement of raw material.* Depending on the type and capacity of the plants to be installed, the requirement of various building materials is usually given in the construction manual. Given

the total number of plants to be constructed in the region by TKWs, total requirement could be worked out. It is normally advisable to purchase the material in bulk; this would not only provide economies of scale but also ensure uniform quality.

4. *Supervision of installation activity.* In order for a non-mason TKW to be able to supervise the construction activity, the person should be given training in basic aspects of biogas technology — relationship between HRT (Hydraulic Retention Time) and digester volume; and dimensions of different components like digester, holder, inlet, and outlet. This would equip them with the necessary wherewithal to ensure quality construction. Also while the construction activity is going on, it is important to keep track of the following activities:

    i. daily work details for each plant vis-a-vis performance of the masons.
    ii. daily material consumption for each plant
    iii. feedback from the trainees
    iv. settlement of accounts
    v. maintenance and monitoring of the plants

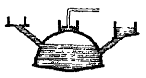
5. *Post-installation services.* This is probably the most important function for TKWs which would decide their future in this sector. Thus training should provide them with necessary skills to undertake minor repairs, and advise the users on complications that may arise.
6. *User education and feedback.* It has been observed that many biogas plants perform below par because of minor problems, for example, water accumulation in the pipe, choking of outlet, etc., which could be easily rectified by the users themselves. Therefore, it is important for TKWs to educate the users so that they do not have to wait for an expert to rectify the problem. Thus, aspects like feeding dung and water in proper ratio and quantity, occasional mixing inside the digester, etc., about which the users have to be informed should be covered in the training given to TKWs.

Staff training. The staff of the implementing agencies at block, district and state levels are expected to closely monitor the programme implementation and prepare periodical reports to be sent to Nodal Departments, and MNES Regional Offices and head quarters. They are also required to closely liaise with banks and TKWs in processing the loans, releasing subsidies, etc. The training provided to them should include evaluation procedures, reporting techniques, etc.

Mason training. While any person experienced in masonry construction could be employed as a mason to build biogas plants, it is desirable that they meet the following criteria:

i. They should be interested in learning about the technology. For this, they should be made aware of the financial benefits that accrue to them by taking up this activity; and
ii. They should be able to construct plants in the village in future as well. Hence masons from within the area or cluster-of-villages are to be preferred.

The persons thus selected should be trained in all the aspects of construction, and provided on-the-job experience by participating in actual construction along with experienced masons.



State Nodal Departments/Agencies for NPBD

Andhra Pradesh
Non-conventional Energy Development
Corporation of Andhra Pradesh
5–8–207–2, Pisgah Complex
Nampally, Hotel Yatrik Compound
Hyderabad 500 001

Arunachal Pradesh
Directorate of Agriculture
Govt. of Arunachal Pradesh
Itanagar 791 111

Assam
Department of Rural Development
Govt. of Assam
Sethi Bhawan, 7th Floor
G.S. Road, Bhangagarh
Guwahati 781 001

Bihar
Bihar Renewable Energy Development Agency
18 Aniket Housing Society
Kidwaipuri
Patna 800 001

Goa
Directorate of Agriculture
Govt. of Goa
Panaji 403 001

Gujarat
Gujarat Agro-Industries Corporation
Khet Udyog Bhawan , Opp. High Court
Navrangpura
Ahmedabad 380 014

Haryana
Directorate of Agriculture
Govt. of Haryana
Chandigarh 160 001

Himachal Pradesh
Directorate of Agriculture
Govt. of Himachal Pradesh
Nalagarh House
Shimla 171 002

Jammu & Kashmir
Department of Agriculture
Govt. of Jammu & Kashmir
Srinagar 190 001

Karnataka
Department of Rural Development &
Panchayati Raj
Govt. of Karnataka
Secretarial Multistoreyed Building
III Stage, III Floor
Bangalore 560 001

Kerala
Department of Agriculture
Govt. of Kerala
Vikas Bhawan
Thiruvananthapuram 695 001

Maharashtra
Department of Rural Development
Mantralaya
Bombay 400 032

Madhya Pradesh
Madhya Pradesh Agro Industries
Corporation
GTB Complex
T.T. Nagar
Bhopal 462 003

Manipur
Department of Science, Technology and
Environment New Secretariat Complex
Govt. of Manipur
Imphal 795 001

Meghalaya
Meghalaya Non-conventional Energy &
Rural Development Agency
Lower Lachaumierre
Opp. P&T Dispensary
Shillong 793 001

Mizoram
Directorate of Animal Husbandry and
Veterinary Services
Govt. of Mizoram
Aizawl 796 001

Nagaland
Department of Rural Development
Govt. of Nagaland
Kohima 797 001

Orissa
Orissa Renewable Energy Development
Agency
S 59 Mancheshwar Industrial Estate
Bhubaneshwar 751 010

Punjab
Directorate of Agriculture
Govt. of Punjab
Chandigarh 160 001

Rajasthan
Special Schemes & Integrated Rural
Development Department Sachivalaya
Govt. of Rajasthan
Jaipur 302 005

Sikkim
New & Renewable Sources of Energy
Department
Govt. of Sikkim
Gangtok 737 101

Tamil Nadu
Department of Rural Development
Govt. of Tamil Nadu
Kuralagam 108
Madras 600 001

Tripura
Department of Agriculture Secretariat
Govt. of Tripura
Agartala 799 001

Uttar Pradesh
Department of Rural Development
Govt. of Uttar Pradesh
Jawahar Bhawan
Lucknow 226 001

West Bengal
Department of Science and Technology
and NCE Sources New Secretariat
Building
Calcutta 700 001

Andaman & Nicobar Islands
Development Commissioner
Port Blair 744 001

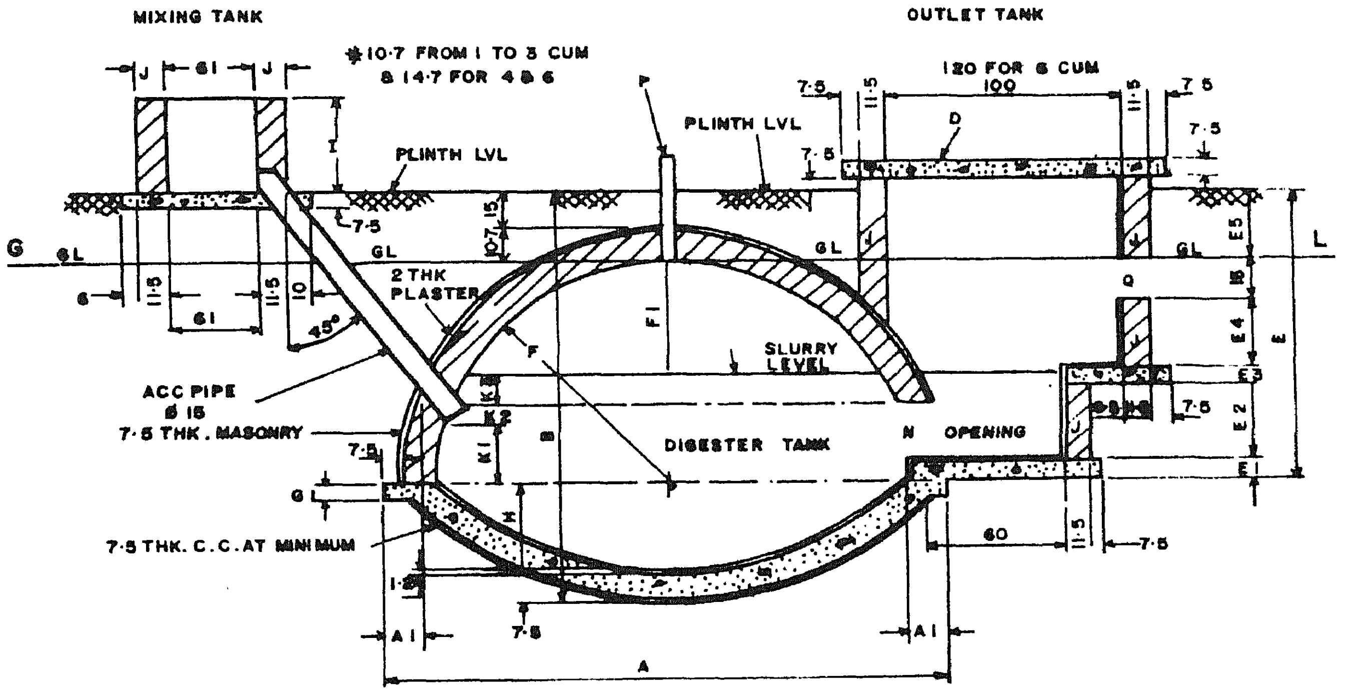
Chandigarh
Department of Rural Development
Chandigarh Administration
Chandigarh 160 001

Dadra and Nagar Haveli
Animal Husbandry-cum-
Veterinary Officer
Silvassa 396 230

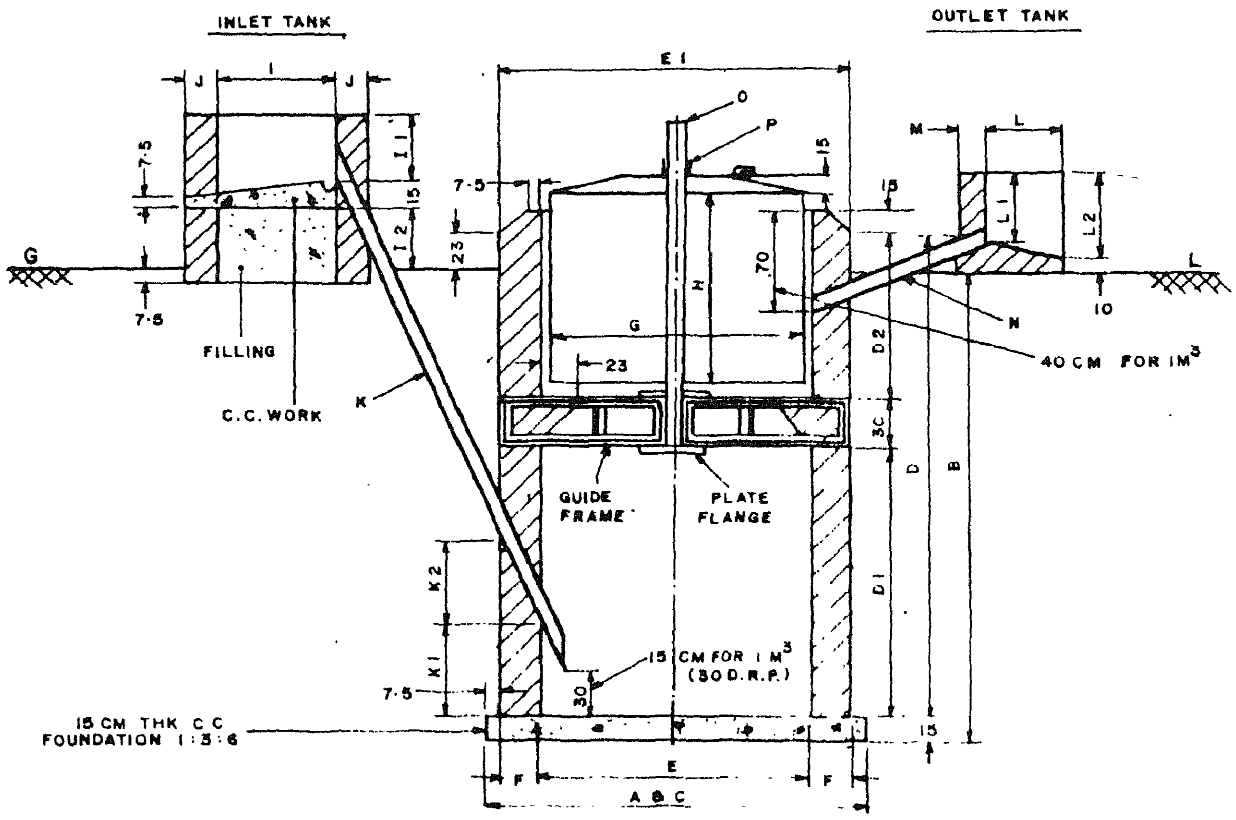
Delhi
Delhi Energy Development Agency,
11 Lancers Road, Timarpur
Delhi 110 007

Pondicherry
Directorate of Agriculture
Pondicherry 605 001

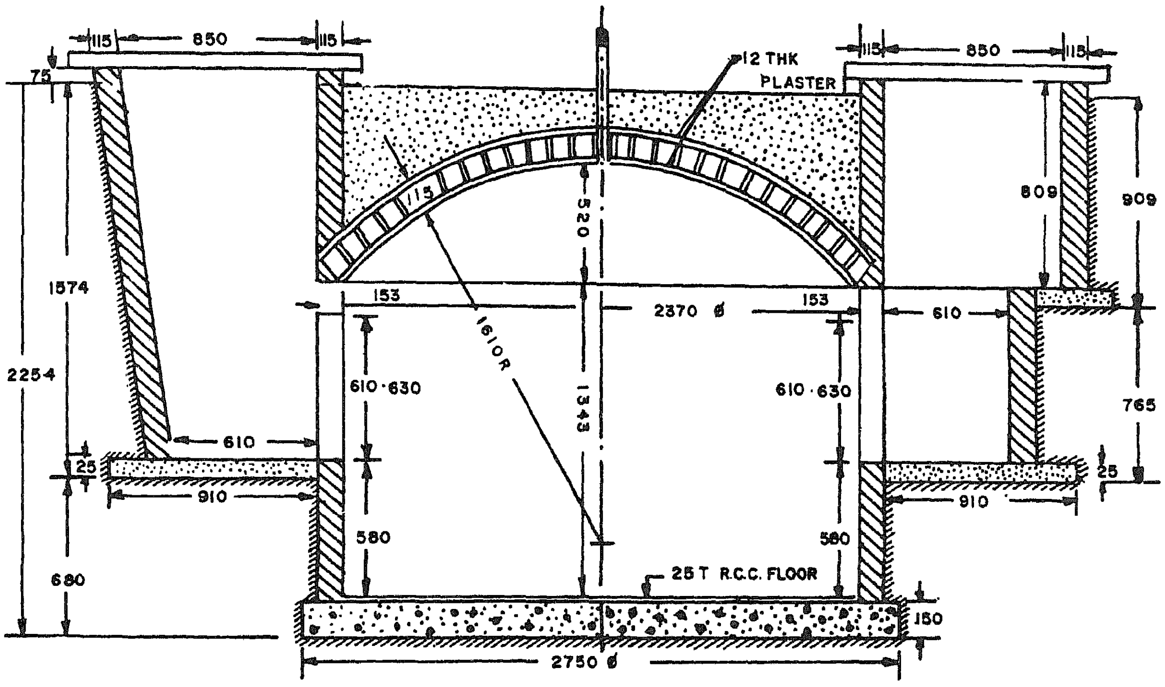
Cross-sectional View of the *Deenbandhu* Model



Cross-sectional View of the *KVIC* Model



Cross-sectional View of the *Janata* Model



Cross-sectional View of the *Pragati* Model